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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KAMERAN AZADET and ERICH FRANZ HARATSCH

Appeal 2008-3242
Application 10/022,659
Technology Center 2600

Decided: October 20, 2008

Before JOSEPH F. RUGGIERO, JOHN A. JEFFERY, and CARLA M. KRIVAK, *Administrative Patent Judges*.

JEFFERY, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134 from the Examiner's rejection of claims 1, 2, 7-10, 12, and 15-29. We have jurisdiction under 35 U.S.C. § 6(b). We affirm-in-part.

STATEMENT OF THE CASE

Appellants invented a method for jointly equalizing and decoding a received signal encoded using a Multilevel Threshold-3 (MLT-3) code.[1] The technique involves generating a trellis that represents both the MLT-3 code and the dispersive channel, and using that trellis to perform joint equalization and decoding of the received signal.[2] Claim 1 is illustrative:

1. A method for decoding a signal received from a dispersive channel causing intersymbol interference, said signal encoded using an MLT-3 code, said method comprising the steps of:

generating at least one trellis representing both said MLT-3 code and said dispersive channel; and

performing joint equalization and decoding of said received signal using said trellis.

The Examiner relies on the following prior art references to show unpatentability:

Trans	US 6,377,640 B2	Apr. 23, 2002 (filed Jul. 31, 1998)
Raghavan	US 6,418,172 B1	Jul. 9, 2002 (filed Apr. 21, 1999)

Erich F. Haratsch & Kamran Azadet, *A Low Complexity Joint Equalizer and Decoder for 1000Base-T Gigabit Ethernet*, IEEE 2000 CUSTOM INTEG. CIRCUITS CONF., 2000, pp. 465-68 ("Haratsch I").

Erich F. Haratsch, *High-Speed VLSI Implementation of Reduced Complexity Sequence Estimation Algorithms with Application to Gigabit Ethernet 1000Baset-T*, VLSI TECH., SYS., AND APPL'NS, 1999, INT'L SYMP., June 8-10, 1999, pp. 171-74 ("Haratsch II").

[1] MLT-3 is a bandwidth-efficient line code used in popular data transmission schemes for local area networks, 100 Base-TX Ethernet (Spec. 1:12-14).
[2] *See generally* Spec. 1:5-2:25.

1. Claims 16-19 and 22 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Raghavan and Trans.
2. Claims 1, 7, 8, 12, and 15 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Raghavan and Haratsch I.
3. Claim 20 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Raghavan, Trans, and Haratsch I.
4. Claims 2, 9, 10, and 23-29 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Raghavan, Haratsch I, and Haratsch II.
5. Claim 21 stands rejected under 35 U.S.C. § 103(a) as unpatentable over Raghavan, Trans, and Haratsch II.

Rather than repeat the arguments of Appellants or the Examiner, we refer to the Briefs and the Answer for their respective details. In this decision, we have considered only those arguments actually made by Appellants. Arguments which Appellants could have made but did not make in the Briefs have not been considered and are deemed to be waived. *See* 37 C.F.R. § 41.37(c)(1)(vii).

FINDINGS OF FACT

The record supports the following findings of fact (FF) by a preponderance of the evidence:

1. Raghavan discloses in Figure 1A a conventional MLT-3 encoder "trellis mapping of random data (signal) bits A(k) to MLT-3 encoded symbols X(k). Each data bit A(k) represents logic data (i.e., 0 or 1), and each X(k) represents symbol data (i.e., +1, 0, or -1)" (Raghavan, col. 3, ll. 38-50; Fig. 1A). Raghavan also discloses an MLT-3 decoder 96 (col. 4, ll. 23-26; Fig. 1B).

2. Trans teaches that each time a logic "1" is encoded in an MLT-3 encoder 324, a transition will occur. But each time a logic "0" is encoded, the previous output level will be maintained for another bit period (Trans, col. 61, ll. 45-56; Fig. 3).

3. Haratsch I discloses a "VLSI architecture for low complexity joint decoding and equalization for a 1000Base-T Gigabit Ethernet" system (Haratsch I, Abstract).

4. In Haratsch I, a four-dimensional symbol is utilized carrying 8 information bits. To combat various channel impairments, including intersymbol interference (ISI), trellis-coded modulation (TCM) is used where the standardized code trellis has 8 code states with 4 branches entering and leaving each state (Haratsch I, at 465, col. 1).

5. According to Haratsch I, several conventional techniques have been reported in the literature that jointly equalize and decode trellis-coded signals corrupted by post-cursor ISI and noise (Haratsch I, at 465, col. 2).

6. Haratsch II uses a Reduced State Sequence Estimation technique that reduces complexity by reducing a trellis in a TCM system that accounts for only the first K of L channel coefficients (Haratsch II, at 172, col. 1).

THE REJECTION OVER RAGHAVAN AND TRANS

We first consider the Examiner's obviousness rejection of claims 16-19 and 22 over Raghavan and Trans (Ans. 3-5). Regarding independent claim 16, Appellants argue that the prior art does not teach or suggest generating each of the recited trellis states with the respective state transitions associated with two binary values, where (1) a first binary value *substantially always* causes a state transition in the trellis from a first state to

a different state, and (2) a second binary value does not cause transition in the trellis as claimed. Appellants emphasize that, unlike the claimed invention, Raghavan's trellis in Figure 1A indicates that the input value "1" *sometimes* causes a transition into the same state, and *sometimes* causes a transition into a different state. As such, Appellants contend, one value in Raghavan does not *substantially always* lead to a state transition as claimed. Appellants add that Trans does not disclose representing an MLT-3 code using a trellis and therefore does not define states or state transitions as in the claimed invention (App. Br. 4-5; Reply Br. 3-4). Moreover, Appellants contend that there is no motivation to combine the references (App. Br. 4; Reply Br. 4).

The Examiner notes that the trellis structure in Figure 4 of the drawings of the present application is structurally identical to that shown in Figure 1A of Raghavan (Ans. 17). The Examiner further indicates that Trans was relied upon as teaching the particular state transitions associated with the two binary values as claimed. According to the Examiner, ordinarily skilled artisans could have utilized such a teaching in Raghavan since the codes used in the references (MLT-3 and TCM) both "admit a trellis representation" (Ans. 17-18).

ISSUE

The issue before us, then, is whether Appellants have shown that the Examiner erred in finding that the limitations of representative claim 16 are taught or suggested by the collective teachings of Raghavan and Trans. The issue turns on whether these references teach or suggest generating each of the recited trellis states with the respective state transitions associated with

two binary values, where (1) a first binary value *substantially always* causes a state transition in the trellis from a first state to a different state, and (2) a second binary value does not cause a state transition in the trellis as claimed.

The issue also turns on whether there is an apparent reason to combine the known elements in the fashion claimed that is supported by articulated reasoning with some rational underpinning to justify the Examiner's obviousness conclusion. For the following reasons, we find that Appellants have not shown such an error.

PRINCIPLES OF LAW

In rejecting claims under 35 U.S.C. § 103, it is incumbent upon the Examiner to establish a factual basis to support the legal conclusion of obviousness. *See In re Fine*, 837 F.2d 1071, 1073 (Fed. Cir. 1988). In so doing, the Examiner must make the factual determinations set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966).

Discussing the question of obviousness of claimed subject matter involving a combination of known elements, *KSR Int'l v. Teleflex, Inc.*, 127 S. Ct. 1727 (2007), explains:

> When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability. For the same reason, if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill. *Sakraida* [*v. AG Pro, Inc.,* 425 U.S. 273 (1976)] and *Anderson's-Black Rock*[*, Inc. v. Pavement Salvage Co.*, 396 U.S. 57 (1969)] are illustrative—a court must ask whether the improvement is more

> than the predictable use of prior art elements according to their established functions.

KSR, 127 S. Ct. at 1740. If the claimed subject matter cannot be fairly characterized as involving the simple substitution of one known element for another or the mere application of a known technique to a piece of prior art ready for the improvement, a holding of obviousness can be based on a showing that "there was an apparent reason to combine the known elements in the fashion claimed." *Id.* at 1740-41. Such a showing requires "some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. . . . [H]owever, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *Id.* at 1741 (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

If the Examiner's burden is met, the burden then shifts to the Appellants to overcome the prima facie case with argument and/or evidence. Obviousness is then determined on the basis of the evidence as a whole and the relative persuasiveness of the arguments. *See In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992).

ANALYSIS

We will sustain the Examiner's obviousness rejection of independent claim 16. We note at the outset that the trellis structure in Figure 4 of the drawings of the present application is structurally identical to that shown in Figure 1A of Raghavan as the Examiner indicates (Ans. 17). This striking similarity is apparent when comparing the two figures as shown below:

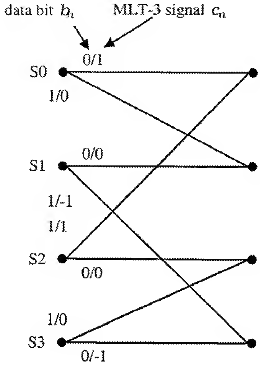
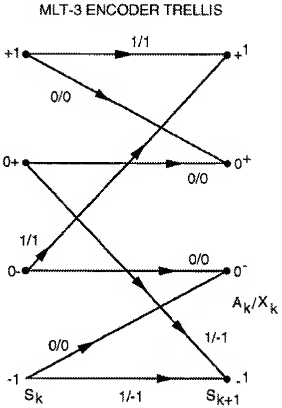
<table>
<tr><th>Figure 4 of the Present Application</th><th>Figure 1A of Raghavan</th></tr>
<tr><td>
</td><td>

FIG. 1A (PRIOR ART)</td></tr>
</table>

Table 1: Side-by-Side Comparison of Figure 4 of the Present Application with Figure 1A of Raghavan

Despite this similarity, Appellants are correct that the labels for the transitions in each of these figures differs (App. Br. 3). For example, the data bit and MLT-3 signal for the first state (top horizontal line) in Figure 4 of the present application is “0/1” whereas the corresponding label for the first state in Figure 1A of Raghavan is “1/1.” Other differences exist with respect to the labels for (1) the transition from the first state to the second

state ("1/0" in the present application; "0/0" in Raghavan); (2) the transition from the fourth state to the third state ("1/0" in the present application; "0/0" in Raghavan); and (3) the straight line for the fourth state ("0/-1" in the present application; "1/-1" in Raghavan).

These differences are not insignificant and, indeed, are relevant to the particular transitions that result from various input values in this trellis. As Appellants point out, unlike the claimed invention, a particular input value (e.g., "1") in Raghavan's trellis structure will *sometimes* result in a state transition and sometimes not. *See, e.g.*, Figure 1A of Raghavan (showing both (1) a straight line at top of the figure from +1 to +1 for "1/1" condition (i.e., no state transition), and (2) a diagonal line from 0- to +1 for "1/1" condition (state transition)).

In contrast, Figure 4 of the present application always causes a state transition for an input value of "1," namely the following conditions: (1) "1/0" (transition from S0 to S1); (2) "1/-1" (transition from S1 to S3); (3) "1/1" (transition from S2 to S0); and "1/0" (transition from S3 to S2). *See* Table 1 above.

Notwithstanding these differences, however, there are nevertheless a limited number of permutations of input values that would achieve a corresponding limited number of state transition results for this particular trellis structure. That is, for this trellis, there are a finite number of identified, predictable solutions based on the particular combination of input value and state transition condition.

As such, selecting a particular solution from these limited options (i.e., correlating particular input values to achieve a particular state transition result from a limited number of such correlations) is, in effect, tantamount to

pursuing known options from a finite number of identified, predictable solutions. Simply put, it would be obvious to try any of the various predictable permutations of input values and corresponding state transition results for this MLT-3 trellis.[3] Such a selection, in our view, would lead ordinarily skilled artisans to the predictable result of the trellis functionality shown in Figure 4 of the present application, namely that (1) a first binary value *substantially always* causes a state transition in the trellis from a first state to a different state, and (2) a second binary value does not cause a state transition in the trellis as claimed.

For this reason alone, we will sustain the Examiner's obviousness rejection based on the collective teachings of the cited prior art. Although we find the Examiner's reliance on Trans merely cumulative to the teachings of Raghavan, we nevertheless find no error in the Examiner's position that the teachings of Trans would at least provide a reason to generate the particular states recited in claim 16 using the trellis of Raghavan.

Trans teaches that each time a logic "1" is encoded in an MLT-3 encoder 324, a transition will occur. But each time a logic "0" is encoded, the previous output level will be maintained for another bit period (Trans, col. 61, ll. 45-56; Fig. 3) (FF 2). While Trans does not state that this transition functionality occurs with respect to a trellis as Appellants argue (App. Br. 5; Reply Br. 3), we see no reason why ordinarily skilled artisans

[3] *See KSR*, at 1742 ("When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense. In that instance the fact that a combination was obvious to try might show that it was obvious under § 103.").

could not at least apply the fundamental principle of this teaching to a trellis-based state transition paradigm, as in Raghavan. In light of this teaching, ordinarily skilled artisans, in our view, could readily adapt Raghavan's trellis to achieve commensurate results with respect to state transitions, particularly in view of the limited number of possibilities provided with such a trellis as noted above.

For the foregoing reasons, Appellants have not persuaded us of error in the Examiner's rejection of independent claim 16. Therefore, we will sustain the Examiner's rejection of that claim, and dependent claims 17-19 and 22 which were not separately argued with particularity (App. Br. 7; Reply Br. 7).

THE REJECTION OVER RAGHAVAN AND HARATSCH I

We now consider the Examiner's obviousness rejection of claims 1, 7, 8, 12, and 15 over Raghavan and Haratsch I (Ans. 5-7). Regarding representative independent claim 1,[4] Appellants argue that the Examiner's reliance on Haratsch I is misplaced since it pertains to trellis-coded modulation (TCM), not MLT-3 codes. According to Appellants, it is not possible to interchange these codes merely because they can be represented with a trellis structure. Appellants note that Haratsch I addresses four-dimensional TCM codes with 8 states, and the various equations and computations pertaining to these codes do not make sense in the context of MLT-3 codes (App. Br. 5-6; Reply Br. 5-6). Appellants add that the

[4] Appellants argue independent claims 1 and 8 together as a group. *See* App. Br. 5-6; Reply Br. 4-6. Accordingly, we select claim 1 as representative. *See* 37 C.F.R. § 41.37(c)(1)(vii).

minimum number of states associated with the present invention (i.e., 4)[5] is lower than Haratsch I—a "surprising result" that further evidences non-obviousness (App. Br. 6; Reply Br. 6).

The Examiner takes the position that since Haratsch I teaches joint equalization and decoding to reduce system complexity (albeit in a TCM system), such a technique could nonetheless be utilized in the MLT-3 system of Raghavan, particularly since both types of coding "admit a trellis representation" (Ans. 20-22).

The issue before us, then, is whether Appellants have shown that the Examiner erred in finding that the collective teachings of Raghavan and Haratsch I teach or suggest the limitations of representative claim 1. The issue turns on whether ordinarily skilled artisans could have improved the MLT-3 system of Raghavan, namely performing joint equalization and decoding of a received signal using a trellis, in view of the teachings of Haratsch I which suggests a similar technique for a TCM system. For the following reasons, we answer "yes" to this question.

Based on the teachings of Haratsch I noted in the Findings of Fact section above (FF 3-5), we find no error in the Examiner's position that ordinarily skilled artisans could have improved the MLT-3 system of Raghavan, namely performing joint equalization and decoding of a received signal using a trellis. We recognize that the joint decoding and equalization technique in Haratsch I is for TCM systems which, as noted above, utilize a trellis with eight code states as Appellants argue (App. Br. 5-6; Reply Br. 5-6) (FF 4). And we further acknowledge that the specific computations and

[5] According to Appellants, the minimum number of states associated with the present invention is 4 x (2^K) = 4 for K=0 (Reply Br. 6).

equations pertaining to such TCM systems with four-dimensional symbols (FF 4) may not be directly applicable to MLT-3 systems as Appellants contend.

Nevertheless, it is well settled that "if a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill." *KSR*, 127 S. Ct. at 1740. It is undisputed that joint equalization and decoding techniques have been used to improve TCM systems as evidenced by Haratsch I (FF 3-5). Indeed, Haratsch I notes that several conventional techniques have been reported in the literature that jointly equalize and decode trellis-coded signals corrupted by post-cursor ISI and noise (FF 5).

Based on the record before us, we see no reason why ordinarily skilled artisans would not at least recognize that such a technique would improve similar systems (e.g., MLT-3 systems such as Raghavan) in the same way. While the requisite computations may differ between these two trellis-based systems to implement this improvement, there is simply no evidence on the record before us to prove that such an application to MLT-3 systems would be beyond the level of ordinarily skilled artisans.

Furthermore, as evidenced by the admitted prior art in Figure 2 of the present application, it is well known that both equalization and decoding functions are conventionally utilized in MLT-3 systems, albeit as separate functions. *See* Spec. 1:20-30; *see also* Fig. 2. In our view, integrating these MLT-3 functions via a joint equalization and decoding technique in a manner similar to that suggested by Haratsch I would have been tantamount

to the predictable use of prior art elements according to their established functions—an obvious improvement. *See KSR*, 127 S. Ct. at 1740.

For the foregoing reasons, Appellants have not persuaded us of error in the Examiner's rejection of independent claim 1. Therefore, we will sustain the Examiner's rejection of that claim, and independent claim 8 which falls with claim 1. We will also sustain the Examiner's rejection of dependent claims 7, 12, and 15 which were not separately argued with particularity (App. Br. 7; Reply Br. 7).

THE REJECTION OVER RAGHAVAN, TRANS, AND HARATSCH I

Likewise, we will sustain the Examiner's obviousness rejection of claim 20 over Raghavan, Trans, and Haratsch I (Ans. 7). As with the other dependent claims noted above, Appellants did not separately argue this claim with particularity and therefore did not specifically point out errors in the Examiner's reasoning to persuasively rebut the Examiner's prima facie case of obviousness (App. Br. 7; Reply Br. 7). Thus, we are not persuaded that the Examiner erred in rejecting claim 20 for the same reasons discussed above. The rejection is therefore sustained.

THE REJECTION OVER RAGHAVAN, HARATSCH I, AND HARATSCH II

Claims 26 and 29

We now consider the Examiner's obviousness rejection of claims 2, 9, 10, and 23-29 over Raghavan, Haratsch I, and Haratsch II (Ans. 8-11). Regarding claims 26 and 29, Appellants argue that the prior art does not teach or suggest that the number of states in the trellis is given by $4 \times (2^K)$ where K is the truncated channel memory (App. Br. 7; Reply Br. 6-7). The

Examiner contends that given the interchangeability of MLT-3 and TCM codes, and further noting Haratsch II's Reduced State Sequence Estimation technique that reduce a trellis in a TCM system based on a subset K of channel coefficients, the recited expression for determining the number of states would have been obvious (Ans. 23-25).

We will not sustain the Examiner's rejection of claims 26 and 29. While Haratsch II does teach reducing a trellis in a TCM system that accounts for only the first K of L channel coefficients (FF 6), we find the Examiner's position dubious at best that this teaching, when combined with the other references, somehow teaches or suggests the recited formula. Certainly, when the truncated channel memory K=0 in the recited formula, then the number of states is 4—the same number of states in Raghavan's Figure 1A as the Examiner indicates (Ans. 24).

But we find nothing in the record before us that reasonably suggests *the particular way that this result is reached as recited in claim 26*, namely by a particular calculation that accounts for the truncated memory in a specific mathematical relationship (i.e., 4 x (2^K)) where K is the truncated channel memory. The Examiner's combination of the various teachings from the three cited references to ostensibly arrive at this formula is speculative at best and simply strains reasonable limits. Accordingly, we will not sustain the rejection of claim 26 and claim 29 for similar reasons.

Claims 2, 9, 10, 21, 23-25, 27, and 28

We will, however, sustain the Examiner's obviousness rejections of (1) claims 2, 9, 10, and 23-25, 27, and 28 over Raghavan, Haratsch I, and Haratsch II (Ans. 8-10), and (2) claim 21 over Raghavan, Trans, and Haratsch II (Ans. 11-12). As with the other dependent claims noted above, Appellants did not separately argue these claims with particularity and therefore did not specifically point out errors in the Examiner's reasoning to persuasively rebut the Examiner's prima facie case of obviousness (App. Br. 7; Reply Br. 7). Thus, we are not persuaded that the Examiner erred in rejecting claims 2, 9, 10, 21, 23-25, 27, and 28 for the same reasons discussed previously. The rejections are therefore sustained.

CONCLUSIONS OF LAW

Appellants have not shown that the Examiner erred in rejecting claims 1, 2, 7-10, 12, 15-25, 27, and 28 under § 103. Appellants have, however, shown that the Examiner erred in rejecting claims 26 and 29 under § 103.

DECISION

The Examiner's decision rejecting claims 1, 2, 7-10, 12, and 15-29 is affirmed-in-part.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART

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